REMARKS

Claims 1 – 48 are currently pending in the application. By this amendment, claims 1, 30, 42, 46 and 47 have been amended. Additionally, by this amendment, claims 16, 17, and 30 have been amended to clarify the term "phi," claims 43 and 48 were amended to correct minor typographical errors, and claims 47 and 48 were amended to recite a "tangibly-embodied" machine readable medium. Additionally, by this amendment, paragraph [0060] has been amended to provide antecedent basis to the specification. Furthermore, new figures have been submitted herewith. Applicant submits that no new matter has been added by this amendment. Support for the above amendments may be found, for example, in the original figures, the original claims and original paragraphs [0044] and [0060]. Reconsideration of the rejected claims in view of the above amendments and following remarks is respectfully requested.

Drawing Objection

The Examiner has objected to the drawings because the Examiner considers Figures 1 – 5 to be illegible. By this amendment, Applicant has submitted replacement drawings for Figures 1 – 5. Accordingly, Applicant respectfully requests that the drawing objection be withdrawn.

Information Disclosure Statement

The Examiner has not considered the following reference cited in the IDS filed September 28, 2005: JP 8 166 6475, JP 8 171 054, JP 8 334 695 and JP 8 330 224. The Examiner has not considered these documents because these are non-English language documents. However, Applicant notes that these non-English language documents each

correspond with a respective U.S. Patent cited in the same IDS. That is: (1) JP 8 166 6475 is also published as US 5,528,118; (2) JP 8 171 054 is also published as US 5,668,672; (3) JP 8 334 695 is also published as US 5,689,377; and (4) JP 8 330 224 is also published as US 5,574,820.

As such, Applicant submits that a written English-language translation has been provided. Accordingly, Applicant respectfully requests that the Examiner consider these references and indicate such consideration by returning a signed and initialed copy of the PTO-1449 Form with the next official communication.

Claim Objections

Claims 44 and 45 were objected to for being of improper dependent form for failing to further limit the subject matter of a previous claim. Additionally, claims 16, 17 and 30 were objected to as the Examiner was not clear what the coefficients are referring to in the claimed equation. Furthermore, claims 34 and 48 were objected to for minor typographical errors.

Claim 44 recites, in pertinent part, "A device manufactured with the exposure apparatus of claim 42." Additionally, claim 45 recites, in pertinent part, "A wafer on which an image has been formed by the exposure apparatus of claim 42." Applicant submits that these claims are in proper dependent form. Applicant respectfully reminds the Examiner of the guidance provided by MPEP § 608.01(n)(III) regarding the infringement test, which states: (emphasis added)

> The test as to whether a claim is a proper dependent claim is that it shall include every limitation of the claim from which it depends (35 U.S.C. 112, fourth paragraph) or in other words that it shall not conceivably be infringed by anything which would not also infringe the basic claim.
>
> A dependent claim does not lack compliance with 35 U.S.C. 112, fourth paragraph, simply because there is a question as to (1) the

> significance of the further limitation added by the dependent claim, or (2) whether the further limitation in fact changes the scope of the dependent claim from that of the claim from which it depends. The test for a proper dependent claim under the fourth paragraph of 35 U.S.C. 112 is whether the dependent claim includes every limitation of the claim from which it depends. The test is not one of whether the claims differ in scope.
>
> Thus, for example, if claim 1 recites the combination of elements A, B, C, and D, a claim reciting the structure of claim 1 in which D was omitted or replaced by E would not be a proper dependent claim, even though it placed further limitations on the remaining elements or added still other elements.
>
> Examiners are reminded that a dependent claim is directed to a combination including everything recited in the base claim and what is recited in the dependent claim. It is this combination that must be compared with the prior art, exactly as if it were presented as one independent claim.
>
> The fact that a dependent claim which is otherwise proper might relate to a separate invention which would require a separate search or be separately classified from the claim on which it depends would not render it an improper dependent claim, although it might result in a requirement for restriction.
>
> The fact that the independent and dependent claims are in different statutory classes does not, in itself, render the latter improper. Thus, if claim 1 recites a specific product, a claim for the method of making the product of claim 1 in a particular manner would be a proper dependent claim since it could not be infringed without infringing claim 1. Similarly, if claim 1 recites a method of making a product, a claim for a product made by the method of claim 1 could be a proper dependent claim. On the other hand, if claim 1 recites a method of making a specified product, a claim to the product set forth in claim 1 would not be a proper dependent claim since it is conceivable that the product claim can be infringed without infringing the base method claim if the product can be made by a method other than that recited in the base method claim.

In view of the above, Applicant submits that claims 44 and 45 are in proper dependent form. That is, Applicant submits claims 44 and 45 satisfy the infringement test set forth above, in that these claims each require every claim feature of the claim from which it depends, i.e., independent claim 42.

Additionally, with regard to claims 16, 17 and 30, which were objected to, as the Examiner was not clear what the coefficients are referring to in the claimed equation, Applicant notes that the Examiner's interpretation of the claim terms was correct. Nonetheless, Applicant has amended claims 16, 17 and 30 to more clearly recite the coefficients of the fitting function.

Furthermore, claims 34 and 48 were objected to for missing periods. By this amendment, Applicant has added periods as suggested by the Examiner.

Accordingly, for at least the above reasons, Applicant respectfully requests the claim objections over claims 16, 17, 30, 34, 44, 45 and 48 be withdrawn.

Specification Objection

The specification was objected to for purportedly failing to provide proper antecedent basis for the recited "machine readable medium." Applicant respectfully disagrees.

Applicant submits that the specification does provide proper antecedent basis for the recited "machine readable medium." For example, Applicant submits that the recited "machine readable medium" is at least discussed at paragraph [0044]. Additionally, Applicant submits that paragraph [0106] contains examples of different tangibly-embodied machine readable medium, which includes, e.g., CD-ROM, amongst other tangibly-embodied machine readable media.

Accordingly, Applicant respectfully requests the objection to the specification be withdrawn.

35 U.S.C. §112, 2nd Paragraph Rejection

Claims 1 – 48 were rejected under 35 U.S.C. § 112, 2nd paragraph for purportedly being indefinite. Applicant respectfully disagrees.

More specifically, with regard to claims 1, 42, 46 and 47, the Examiner asserts that it is unclear where the "specified aberration values" come from. Additionally, the Examiner is not clear as to whether the recited "aberration components" are similar to the recited "specified aberration values." Applicant disagrees.

Applicant notes that looking to the specification for the purpose of interpreting or defining a recited claim term is not an improper attempt to read limitations from the specification into the claims. More specifically, MPEP §2111 notes:

> ... reading a claim in light of the specification, to thereby interpret limitations explicitly recited in the claim, is a quite different thing from 'reading limitations of the specification into a claim,' to thereby narrow the scope of the claim by implicitly adding disclosed limitations which have no express basis in the claim. *In re Prater*, 415 F.2d 1393, 1404-05, 162 USPQ 541, 550-51 (CCPA 1969)

Applicant submits that the aberration components and the specified aberration values are explained at least at paragraphs [0068] and [0069], which state: (emphasis added)

> [0068] A function is built (through fitting techniques to represent this change of surface plot as a function of A_2 value. This is represented as the function `surf$A_2$ ($A_2$,x,y)` in Equation (5), describing a surface plot (e.g., image intensity or amplitude as a function of x/y position within the image plane region) which varies as a function of the input variable A_2. It is only necessary to supply a value of A_2, and the shape of the surface function is fully known and described. Likewise, a similar function is built for each of the various aberration components and their associated coefficients, each providing a full description (in the form of a mathematical function) of the image profile plot that varies depending upon the input value of the given coefficient.
>
> [0069] Thus, when presented with a set of Zernike Coefficients representing the aberration at a specified field point, the invention may calculate the final "aberrated image profile" through the simple summing of each of the separate image profile plots, each of which is responding only to a single aberration coefficient value. In this application and aspect of the invention, a linear response is assumed between the various aberration coefficients. This is supported mathematically and many times in practice due to the mathematical orthogonality between all of the terms of the Zernike Polynomial series. Mathematical

> orthogonality basically describes the fact that each of the various terms are unaffected by a change in value of any of the other terms.

Thus, Applicant submits that the invention discloses building functions for each of the various aberration components and their associated coefficients, each providing a full description (in the form of a mathematical function) of the image profile plot. Moreover, the building of these function is performed once. Thus, the aberration components are used to build the recited response surface functional relations.

Furthermore, in accordance with the invention, these built functions or functional relations may be used to determine a final "aberrated image profile" for a specified aberration value. More specifically, a particular aberration value will be specified, e.g., by a user. Moreover, the present invention is operable to calculate the final "aberrated image profile" for this specified aberration value through the simple summing of each of the separate image profile plots, each of which is responding only to a single aberration coefficient value.

Thus, Applicant submits that the specification clearly sets forth the "specified aberration values." Additionally, as explained above, Applicant submits that the recited "aberration components" are different from the recited "specified aberration values."

With regard to claim 2, the Examiner is not clear what the term "adjustment goodness" means. Applicant respectfully submits that "goodness" is a term of art well known to those of ordinary skill in the art of optics. Additionally, with regard to the Examiner's comments that "steps are used" seems to be an intended use, Applicant notes that claim 2 is a method claim. As such, the "steps are used" features of claim 2 should be given patentable weight, as they further define the claimed method.

With regard to claim 15, the Examiner asserts that it is not clear how the evaluating step "eliminates the need for full simulation." Applicant respectfully disagrees. Applicant submits that the specification clearly sets forth how the evaluating step eliminates the need for a full simulation calculation each and every time new specified aberration values are provided and presented for calculation of a new image profile. For example, paragraphs [0054] and [0055] state: (emphasis added)

> [0054] The invention is directed to a system and method for calculating estimated image profiles resulting from imaging in the presence of lens aberrations. The system and method significantly reduces processing times for calculating image profiles by executing only the evaluation of a simple function at the values specified for the aberration components. In more specificity, the system and method makes use of propagated aerial image calculations in a "setup" phase; however, this is performed only once for a given imaging configuration, which significantly reduces the need for additional processing resources during the subsequent calculation of image profiles for many various combinations of aberration components (representing various field positions within an exposure field, as well as various lens adjustment "states", i.e., combinations of lens element adjustments). These "setup" simulations may be used as input data to load an "Image Profile Calculator" that is realized by the invention.
>
> [0055] Following the setup simulations and loading of the Image Profile Calculator, all further Image Profiles may then subsequently be directly calculated using the established "aberration sensitivities". By such direct calculation via evaluation of a fixed function, the invention effectively bypasses the need to have direct access to a commercial image simulation software package (at any time following the execution of the setup simulations).

Thus, Applicant submits that the specification clearly sets forth how the evaluating step eliminates the need for full simulation calculation each and every time new specified aberration values are provided and presented for calculation of a new image profile.

With regard to claim 21[1], Applicant notes that claim 21 is a method claim. As such, the phrase "leads to" further defines the method, and thus, is entitled to patentable weight.

With regard to claim 47, Applicant has amended claim 47 to address the Examiner's concerns.

With regard to claims 43 and 48, the Examiner asserts that the term "defined criteria" renders these claims indefinite, as it is unclear what criteria is being referred to. Applicant has amended paragraph [0060] to provide antecedent basis for this term in the claims. Applicant submits that no new matter has been added by this amendment. Support for this amendment may be found, for example, at original claims 43, 46 and 48.

Additionally, with regard to claims 43 and 48 the Examiner asserts that the term "judges" renders these claims indefinite, as it could raise questions as to how the judgment is done. Applicant disagrees. Applicant submits that the recited judging is discussed at least at paragraph [0038] which states: (emphasis added)

> [0038] In an aspect of the invention, a mechanism may be provided for evaluating specified aberration values of a lens in terms of the impact on image profile through the response surface functional relations to judge the "goodness" or "badness" of each considered lens adjustment combination, where each lens adjustment combination to be considered is defined as a new set of aberration coefficients. From the aberration coefficients, a direct calculation of the image profile through application of the present invention is executed.

Thus, Applicant submits that the recited judging is clearly set forth in the specification. As such, Applicant submits that the term "judges" does not render these claims indefinite.

[1] Applicant notes that the Examiner referred to claim 22. However, Applicant believes the Examiner intended to refer to claim 21. Thus, Applicant will address this objection as if it were made to claim 21.

With regard to claims 44 and 45, the Examiner asserts that " . . . since the claim does not set forth any steps involved in the method/process, it is unclear what method/process applicant is intending to encompass." As discussed above, claims 44 and 45 are proper device claims. That is, claims 44 and 45 satisfy the infringement test for a determination of proper dependent claims. As such, Applicant respectfully submits that the Examiner's treatment of these claims as method claims and his rejection of these claims under 35 U.S.C. § 112, 2nd paragraph based on the assertion that these claims do not set forth any steps involved in the method/process is unsupportable.

Accordingly, for at least these reasons, Applicant respectfully requests that the rejections of claims 1 – 48 under 35 U.S.C. § 112, 2nd paragraph be withdrawn.

35 U.S.C. §101 Rejections

Claims 44, 45, 47 and 48 were rejected under 35 U.S.C. § 101 as purportedly being directed to non-statutory subject matter. Specifically, with regard to claims 44 and 45, the Examiner asserts that the claimed invention does not fall into one of the four categories of patent eligible subject matter recited in 35 U.S.C. §101 (process, machine, manufacture or composition of matter). Applicant respectfully disagrees.

Applicant submits that claim 44 is directed to a device, which falls into at least one of the four categories of patent eligible subject matter recited in 35 U.S.C. §101 (process, machine, manufacture or composition of matter). Namely, a device is a machine. Furthermore, Applicant submits that claim 45 is directed to a wafer, which falls into at least one of the four categories of patent eligible subject matter recited in 35 U.S.C. §101 (process, machine, manufacture or

composition of matter). Namely, a wafer is a machine. Moreover, as discussed above, Applicant respectfully submits that claims 44 and 45 are in proper dependent form. As such, Applicant submits that claims 44 and 45 are directed to statutory subject matter.

With regard to claims 47 and 48, the Examiner asserts that these claims are directed to non-statutory subject matter. Applicant has amended claims 47 and 48 to address the Examiner's rejection. More specifically, Applicant has amended claims 47 and 48 to recite a tangibly-embodied machine readable medium. Thus, Applicant submits that claims 47 and 48 are directed to a tangibly-embodied machine readable medium, which falls into at least one of the four categories of patent eligible subject matter recited in 35 U.S.C. §101 (process, machine, manufacture or composition of matter). Namely, a tangibly-embodied machine readable medium is a machine. Accordingly, Applicant submits that claims 47 and 48 are directed to statutory subject matter.

Thus, for at least the reasons set forth above, Applicant respectfully requests the rejections under 35 U.S.C. § 101 be withdrawn.

35 U.S.C. §102 Rejections

Claims 1 – 27, 30 – 41 and 46 - 48 were rejected under 35 U.S.C. §102(a) for being anticipated by "Impact of Zernike cross-term on linewidth control," published July 15, 2002 (hereinafter "Impact"). This rejection is respectfully traversed.

To anticipate a claim, each and every element as set forth in the claim must be found, either expressly or inherently described, in a single prior art reference. MPEP § 2131. Applicant respectfully submits that Impact does not disclose each feature of the present invention.

Independent Claims 1, 30, 46 and 47

The present invention relates to a system and method for calculating image profiles on a surface. Claim 1 recites, in pertinent part:

> . . . providing imaging configuration characteristic data;
>
> performing simulation calculations for various levels for each aberration component using the imaging configuration characteristic data;
>
> building response surface functional relations between variables of lens characteristics and an image profile of interest using the simulation calculations; and
>
> evaluating specified aberration values of a lens in relation to the response surface functional relations to provide an estimate of the image profile in a presence of specified aberration(s).

Claim 30 recites, in pertinent part:

> . . . performing simulation calculations for various levels for each aberration component using image configuration characteristic data;
>
> building response surface functional relations between variables of the image configuration characteristics and the image profile of interest using the simulation calculations as data input to be fit using:

$$I_{spx}(x) = b_0 + b_1 x + b_2 x^2 + b_3 x^3 + ... + b_n x^n$$

> where I_{spx} indicates aerial image intensity or amplitude at a simulation pixel *(spx)* and x indicates defocus; and
> expressing a change of the coefficients $b_0 \ldots b_n$ described by an order fitting function as:

$$b_{i(with\_aberration)} = b_{i(w/o\_aberration)} + \sum_{j=2}^{Zn} \Delta b_i(cj)$$

$$= b_{i(w/o\_aberration)} + \sum_{j=2}^{Zn} \varphi_{0(i,j)} + \varphi_{1(i,j)} c_j + \varphi_{2(i,j)} c_j^{\,2} + \varphi_{3(i,j)} c_j^{\,3} + ... + \varphi_{n(i,j)} c_j^{\,n}$$

> wherein
>
> $b_{i(with\ aberration)}$ and $b_{i(w/o\ aberration)}$ represents the coefficients $b_0 \ldots b_n$ influenced by lens aberrations and the coefficients $b_0 \ldots b_n$ without aberrations, respectively,
>
> Δbi indicates the change in coefficients and it is expressed by an n^{th} order fitting function of jth Zernike coefficient c_j; and
>
> $\varphi_{0(i,j)} \ldots \varphi_{n(i,j)}$ are the coefficients of the fitting function; and

summing an impact from at least one of all new specified aberration coefficients and combinations of aberration coefficients from the built response surface functional relations to provide lens adjustment data.

Claim 46 recites, in pertinent part:

. . . means for performing simulation calculations for various levels for each aberration component using characteristic data;

means for building response surface functional relations between variables of lens characteristics using the simulation calculations;

means for evaluating specified aberration values of a lens in relation to the response surface functional relations to provide image profile estimates for the specified aberration values; and

means for applying the aberrated image profile estimates in an optimization calculation method which judges image profile information against defined criteria as part of a lens adjustment optimization calculation.

Claim 47 recites, in pertinent part:

. . . performing simulation calculations for various levels for each aberration component using characteristic data;

building response surface functional relations between variables of lens characteristics using the simulation calculations; and

evaluating specified aberration values of a lens in relation to the response surface functional relations to provide image profile estimates for the specified aberration values.

In addressing previously presented claims 1, 30, 46 and 47, the Examiner asserts that Impact discloses each of the features of the present invention at page 33, Section 2, paragraph 1, tables 1 and 2, the abstract, page 34, lines 1 – 6 and 12 – 17. Applicant disagrees.

In any event, in order to expedite prosecution, Applicant amended claims 1, 30, 46 and 47 to clarify that simulation calculations are performed for various levels for each aberration component. Applicant submits that Impact does not disclose each of the features of the present invention. For example, Applicant submits that Impact does not disclose performing simulation calculations for various levels for each aberration component using characteristic data, and

building response surface functional relations between variables of lens characteristics using the simulation calculations, as recited in claims 1, 30, 46 and 47. Instead, as discussed below, Impact only performs a simulation calculation using a single level or value for each Zernike component.

No Disclosure of Performing Simulation Calculations for Various Levels for Each Aberration Component

Applicant submits that Impact does not disclose performing simulation calculations for various levels for each aberration component using characteristic data. As should be understood by one of ordinary skill in the art, a Zernike component is a type of aberration component.

In addressing previously presented claims 1, 30, 46 and 47, the Examiner asserts that Impact discloses performing simulation calculations for various levels of aberration components using characteristic data at page 33, Section 2, paragraph 1 and page 34, lines 1 – 6 and 12 – 17. Applicant has reproduced these portions of Impact below, which state (emphasis added):

> Recently, ZSM [Zernike sensitivity method] has been introduced as one of the methods to understand influence of various Zernike components on the lithographic performance. ZSM has been also used to select lenses best suited from the target feature patterning. Below, we present ZSM procedures illustrated by examples of two lithographic performances, linewidth abnormality (LWA) and best focus shift (BFS).
>
> Table 1 and 2 present the exposure simulation assumptions used for LWA and BFS ZSMs. As the tables indicate, Zernike sensitivity calculation is specific to lithographic condition, illumination condition, mask type, and, of course, the target feature designs. The target patterns for the LWA and the BFS are presented in Figures 1 and 2.
>
> First step for ZSM is to conduct aerial image calculations of LWA or BFS. It is done for a set of arbitrary input coefficients, one for each Zernike component.

In view of the above, Applicant submits that Impact discloses that aerial image calculations are done for a set of arbitrary input coefficients, one for each Zernike component. The instant disclosure discusses such conventional methods at paragraph [0008], disclosing that a typical current image simulation technique uses a very complex calculation for simulating an image profile on the wafer. However, with this simulation technique, a new calculation of a propagated aerial image is required each and every time a different set of aberration component values (most typically represented as Zernike Polynomial coefficient values, in current practice) is to be considered by the simulation environment.

That is, for each set of new aberration components for which a corresponding image profile is desired: (i) a mathematical series (or the coefficients of an agreed-upon series) must be provided as input, describing the aberrations in the lens when imaging at a single exposure field position to be considered; (ii) an aberration calculation is performed for each new set of aberration components (i.e., the value of the series representing the aberration is calculated at each position within the pupil-plane of the simulated lens being considered); and (iii) a final image simulation calculation is performed using the new pupil-plane aberration representation. Moreover, as noted in paragraph [0012], this sort of "full" image simulation calculation can result in a time consuming and mathematically intensive process that must be repeated with for, e.g., each considered lens adjustment. In comparison, the present invention requires calculations at a setup phase regardless of, e.g., which lens adjustment is being considered.

Thus, Applicant submits Impact describes a method in accordance with the above-described conventional approach. That is, Applicant submits Impact discloses a current

image simulation technique wherein, a new calculation of a propagated aerial image is required each and every time a different set of aberration component values (most typically represented as Zernike Polynomial coefficient values, in current practice) is to be considered by the simulation environment. In other words, with Impact for each set of new aberration components (with a single value for each aberration component) for which a corresponding image profile is desired, steps (i) – (iii) must be performed. This is in comparison to the present invention, where calculations are performed only once during a setup phase regardless of, for example, each lens adjustment considered. This is noted in the specification at paragraph [0054].

More specifically, in contrast to the above-described conventional method disclosed in Impact, the present invention is directed to a method and system for calculating estimated image profiles resulting from imaging in the presence of lens aberrations, as disclosed in the instant specification at paragraph [0054]. More specifically, the system and method make use of propagated aerial image calculations in a "setup" phase. During this "setup" phase, propagated aerial image calculations are performed for various levels for each Zernike component. This allows the present invention to only make calculations at the setup phase, and still provide the image profile estimates without further simulation calculations, even if, for example, a lens adjustment change is considered. This is contrasted with requiring a simulation calculation, e.g., for each lens adjustment change, shown in Impact. As such, the present invention performs simulation calculations for various levels for each aberration component, as recited in claims 1, 30, 46 and 47.

For example, Figures 3a – 3k of the present invention illustrate the recited simulation calculations for various levels for each aberration component. More specifically, Figures 3a – 3k of the present invention show a series of image profile surface plots, each resulting from a full simulation calculation using a different entered value of Zernike #2, representing a response surface. Moreover, as can be observed in Figures 3a – 3k, the value of Zernike #2 is varied from -0.025 waves rms to +0.025 waves rms. Furthermore, while Figures 3a – 3k show the series of image profile surface plots using a different entered value of Zernike #2, it should be understood that a series of image profile surface plots are calculated for each Zernike component. That is, for each Zernike component, a series of image profile surface plots are generated for different values of that Zernike component. As such, the present invention performs simulation calculations for various levels for each aberration component, as recited in claims 1, 30, 46 and 47.

As further disclosed at paragraph [0055], following the setup simulations and loading of the Image Profile Calculator, all further Image Profiles may then subsequently be directly calculated using the established "aberration sensitivities". By such a direct calculation via evaluation of a fixed function, the invention effectively bypasses the need to have direct access to a commercial image simulation software package (at any time following the execution of the setup simulation.

Thus is, in view of the above, in contrast to the present invention where propagated aerial image calculations are performed for <u>various values or levels for each aberration component</u>, Applicant respectfully submits, with Impact propagated aerial

image calculations are performed for a set of arbitrary input coefficients, with one level or value for each aberration (e.g., Zernike) component.

As such, Applicant submits that Impact does not disclose performing simulation calculations for various levels for each aberration component using characteristic data, as recited in claims 1, 30, 46 and 47, and does not anticipate the claimed invention.

No Disclosure of Building Response Surface Functional Relations Using Simulation Calculations

Furthermore, Applicant submits that Impact does not disclose building response surface functional relations between variables of lens characteristics using the simulation calculations. That is, as discussed above, Applicant submits that Impact does not disclose performing simulation calculations for various levels for each aberration component. As such, Applicant submits that Impact cannot disclose building response surface functional relations between variables of lens characteristics using the simulation calculations.

Therefore, Applicant submits that Impact does not disclose building response surface functional relations between variables of lens characteristics using the simulation calculations, as recited in claims 1, 30, 46 and 47, and does not anticipate the claimed invention.

Additionally, with regard to claim 30, Applicant submits that the Examiner did not address each feature of claim 30. More specifically, the Examiner never addressed the feature of:

. . . using the simulation calculations as data input to be fit using:

$$I_{spx}(x) = b_0 + b_1 x + b_2 x^2 + b_3 x^3 + ... + b_n x^n$$

where I_{spx} indicates aerial image intensity or amplitude at a simulation pixel *(spx)* and x indicates defocus; and
expressing a change of the coefficients $b_0 \ldots b_n$ described by an order fitting function as:

$$b_{i(with\_aberration)} = b_{i(w/o\_aberration)} + \sum_{j=2}^{Zn} \Delta b_i(cj)$$

$$= b_{i(w/o\_aberration)} + \sum_{j=2}^{Zn} \varphi_{0(i,j)} + \varphi_{1(i,j)} c_j + \varphi_{2(i,j)} c_j^{\,2} + \varphi_{3(i,j)} c_j^{\,3} + \ldots + \varphi_{n(i,j)} c_j^{\,n}$$

wherein

$b_{i(with\ aberration)}$ and $b_{i(w/o\ aberration)}$ represents the coefficients $b_0 \ldots b_n$ influenced by lens aberrations and the coefficients $b_0 \ldots b_n$ without aberrations, respectively,

Δbi indicates the change in coefficients and it is expressed by an n^{th} order fitting function of jth Zernike coefficient c_j; and

$\varphi_{0(i,j)} \ldots \varphi_{n(i,j)}$ are the coefficients of the fitting function

Rather, the Examiner merely asserts that Impact discloses each of the recited features of claim 30 without addressing the above-noted feature. As such, as discussed further below, Applicant submits that the Examiner has set forth an incomplete and unclear record and has not set forth a *prima facie* case of anticipation. In any event, Impact does not disclose performing simulation calculations for various levels of aberration components, as discussed above.

Dependent Claims 2 –27, 31 – 41 and 48

Claims 2 – 27, 31 – 41 and 48 are dependent claims, depending from respective distinguishable base claims. Accordingly, these claims should also be in condition for allowance based upon their respective dependencies and because these claims recite further distinguishing features.

Claim 16

Additionally, with regard to claim 16, Applicant submits that the Examiner did not address each feature of claim 16. That is, claim 16 recites, in pertinent part:

> . . . wherein the building steps includes:
> providing an order fitting function expressed as:
> $I_{spx}(x) = b_0 + b_1 x + b_2 x^2 + b_3 x^3 + ... + b_n x^n$
> where I_{spx} is aerial image intensity or amplitude at a simulation pixel *(spx)* and x indicates defocus; and
> expressing a change of the coefficients $b_0 \ldots b_n$ described by an order fitting function expressed as:
>
> $$b_{i(with\_aberration)} = b_{i(w/o\_aberration)} + \sum_{j=2}^{Zn} \Delta b_i(cj)$$
>
> $$= b_{i(w/o\_aberration)} + \sum_{j=2}^{Zn} \varphi_{0(i,j)} + \varphi_{1(i,j)} c_j + \varphi_{2(i,j)} c_j^{\,2} + \varphi_{3(i,j)} c_j^{\,3} + ... + \varphi_{n(i,j)} c_j^{\,n}$$
>
> wherein
> $i = 0, 1, 2, 3, ..., n;$
> $b_{i(with\ aberration)}$ and $b_{i(w/o\ aberration)}$ represents one of the coefficients $b_0 \ldots b_n$ influenced by lens aberrations and the coefficients $b_0 \ldots b_n$ without aberrations, respectively, and
> Δbi indicates the change in coefficients and is expressed by an n^{th} order fitting function of jth Zernike coefficient c_j,
> $\varphi_{0(i,j)} \ldots \varphi_{n(i,j)}$ are the coefficients of the fitting function, determined following the performing step of setup simulations of image profile as a function of regularly iterated values of lens aberration.

However, in addressing claim 16, while asserting that Impact discloses each of the features of claim 16, the Examiner did not address the above-noted feature. Rather, the Examiner merely asserts that Impact discloses a fitting function. As such, Applicant submits that the Examiner's treatment of claim 16 is *per se* improper, as the Examiner did not address each of the recited features of claim 16.

Claims 31 – 41

Additionally, with regard to claims 31 – 41, Applicant submits that the Examiner did not properly treat these claims. Applicant respectfully reminds the Examiner of the guidance provided by MPEP § 707.07(d), which states (emphasis added):

> A plurality of claims should never be grouped together in a common rejection, unless that rejection is equally applicable to all claims in the group.

In treating claims 31 – 41, the Examiner refers to the treatment of claims 3, 4, 6 – 8, 18 – 20, 23, 24 and 26. However, Applicant submits that the rejection of claims 31 – 41 is not equally applicable to claims 3, 4, 6 – 8, 18 – 20, 23, 24 and 26. That is, claims 31 – 41 depend from independent claim 30 which recites different features than independent claim 1, from which claims 3, 4, 6 – 8, 18 – 20, 23, 24 and 26 depend. As such the rejection of claims 3, 4, 6 – 8, 18 – 20, 23, 24 and 26 is not equally applicable to claims 31 – 41.

Additionally, Applicant submits that both claims 34 and 35 recite features that are not recited in any of claims 3, 4, 6 – 8, 18 – 20, 23, 24 and 26. Thus, for this additional reason, Applicant submits that the rejection of claims 3, 4, 6 – 8, 18 – 20, 23, 24 and 26 is not equally applicable to claims 34 and 35. As such, Applicant submits that the treatment of at least claims 34 and 35 is *per se* improper. Thus, as discussed further below, Applicant respectfully submits that the Examiner has not set forth a complete action or a clear record.

Accordingly, for at least these reasons, Applicant respectfully requests that the rejection of claims 1 – 27, 30 – 41 and 46 – 48 be withdrawn.

35 U.S.C. § 103 Rejection

Claims 28, 29, 42 and 43 were rejected under 35 U.S.C. §103(a) as being unpatentable over Impact in view of "Method of Zernike Coefficient Extraction for Optics Aberration Measurement" authored by Shiode et al. ("Extraction"). This rejection is respectfully traversed.

The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness. See MPEP §2142. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings.[2] Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Applicant submits that the combination of reference do not teach or suggest each of the features of the present invention.

[2] While the *KSR* court rejected a rigid application of the teaching, suggestion, or motivation ("TSM") test in an obviousness inquiry, the [Supreme] Court acknowledged the importance of identifying "a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does" in an obviousness determination. *Takeda Chemical Industries, Ltd. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1356-1357 (Fed. Cir. 2007) (quoting *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007)).

Independent Claim 42

Claim 42 recites, in pertinent part:

> . . . an illumination system that projects radiant energy through a mask pattern on a reticle R that is supported by and scanned using a wafer positioning stage;
>
> at least one linear motor that positions the wafer positioning stage;
>
> a system for providing optimal image profiling, including:
>
> means for providing image configuration characteristic data;
>
> means for performing simulation calculations for various levels for each aberration component using the image configuration characteristic data;
>
> means for building response surface functional relations between variables of lens characteristics associated with the image configuration characteristic data using the simulation calculations; and
>
> means for evaluating specified aberration values of a lens in relation to the response surface functional relations to provide image profile estimates for the specified aberration values.

In addressing previously presented claim 42, the Examiner asserts that Impact discloses all of the recited features except for an illumination system that projects radiant energy through a mask pattern on a reticle R that is supported by and scanned using a wafer positioning stage. However, the Examiner asserts that Extraction discloses an illumination system that projects radiant energy through a mask pattern on a reticle R that is supported by and scanned using a wafer positioning stage and that it would have been obvious to combine these teachings to arrive at the instant invention. Applicant disagrees.

For the reasons set forth above with regard to claims 1, 30, 46 and 47, Applicant submits that Impact does not teach or suggest means for performing simulation calculations for various levels for each aberration component using the image configuration characteristic data, and does not teach or suggest means for building response surface functional relations between variables of lens characteristics using the simulation calculations. Applicant notes that the

Examiner did not assert that Extraction teaches or suggests means for performing simulation calculations for various levels of aberration components using the image configuration characteristic data, and did not assert that Extraction teaches or suggests means for building response surface functional relations between variables of lens characteristics using the simulation calculations.

Moreover, Applicant submits that Extraction does not cure the deficiencies of Impact. That is, Applicant submits that Extraction does not teach or suggest means for performing simulation calculations for various levels for each aberration component using the image configuration characteristic data or means for building response surface functional relations between variables of lens characteristics using the simulation calculations. Rather, Applicant submits that Extraction discloses a Zernike Extraction (ZEM) method that excludes the necessity of phase measurement interferometers (PMI), focusing on absolute measurement of Zernike coefficients.

As such, Applicant submits that Impact in view of Extraction does not teach or suggest each of the features of claim 42, and does not render the present invention unpatentable.

Dependent Claims 28, 29 and 43

Claims 28, 29 and 43 are dependent claims, depending from respective distinguishable base claims. Accordingly, these claims should also be in condition for allowance based upon their respective dependencies and because these claims recite further distinguishing features.

Claim 28

Additionally, with regard to claim 28, the Examiner takes Official Notice that "it was known at the time of the invention to implement the building and evaluating steps using a sinusoidal fitting function." Moreover, the Examiner asserts "[t]his implementation would have been obvious because one of ordinary skill in the art would be motivated to change quadratic Zernike fitting function to sinusoidal fitting functions using well know trigonometric functions."

Applicant reminds the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Applicant submits that facts asserted by the Examiner to be well-known, or to be common knowledge in the art are not capable of instant and unquestionable demonstration as being well-known. Accordingly, Applicant respectfully requests that the Examiner produce documentary evidence to support the Examiner's assertions of official notice.

Moreover, Applicant submits that the Examiner has not set forth a proper *prima facie* case of obviousness. That is, the Examiner has not set forth any motivation for combining Extraction with Impact. Rather, the Examiner merely asserts that it would have been obvious to do so using well known trigonometric functions.

Claim 29

Additionally, in treating claim 29, the Examiner merely refers to the rejection of claim 28. Applicant again remind the Examiner of the guidance provided by MPEP § 707.07(d), which states (emphasis added):

> A plurality of claims should never be grouped together in a common rejection, unless that rejection is equally applicable to all claims in the group.

Applicant submits that the rejection of claim 28 is not equally applicable to claim 29. For example, Applicant submits that claim 29 recites features that are not recited in claim 28. Thus, Applicant submits that the Examiner has not addressed the features of claim 29. As such, Applicant submits that the treatment of claim 29 is *per se* improper. Moreover, with regard to the Examiner's taking of official notice, Applicant respectfully requests that the Examiner produce documentary evidence to support the Examiner's assertions of official notice.

Accordingly, for at least these reasons, Applicant respectfully requests that the rejection of claims 28, 29, 42 and 43 be withdrawn.

Complete Action Not Provided

As discussed above, Applicant submits that the Examiner has not provided a complete action. More specifically, with regard to claims 16 and 30, Applicant submits the Examiner never addressed each of the features of claims 16 and 30. Additionally, with regard to claims 29, 34 and 35, Applicant submits the Examiner never addressed each of the features of these claims having improperly grouped the rejection of these claims with other claims, as discussed above.

Furthermore, with regard to claim 28, Applicant submits the Examiner did not set forth a *prima facie* case of obviousness.

For at least these reasons, Applicant submits that a clear issue was not developed between the Examiner and Applicant. More specifically, MPEP §706 states:

> Before final rejection is in order a clear issue should be developed between the examiner and applicant. To bring the prosecution to as speedy conclusion as possible and at the same time to deal justly by both the applicant and the public, the invention as disclosed and claimed should be thoroughly searched in the first action and the references fully applied; and in reply to this action the applicant should amend with a view to avoiding all the grounds of rejection and objection.

Additionally, MPEP 706.07(a) notes:

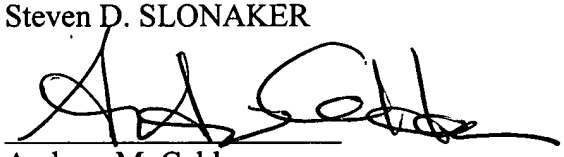
> Under present practice, second or any subsequent actions on the merits shall be final, except where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims nor based on information submitted in an information disclosure statement filed during the period set forth in 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p). ...
>
> Furthermore, a second or any subsequent action on the merits in any application ... will not be made final if it includes a rejection, on newly cited art, other than information submitted in an information disclosure statement filed under 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17 (p), of any claim not amended by applicant or patent owner in spite of the fact that other claims may have been amended to require newly cited art.

Accordingly, Applicant respectfully requests that the Examiner address the untreated features of the claimed invention set forth in claims 16, 29, 30 and 31 – 41, such that a clear issue is developed between the Examiner and Applicant. Moreover, Applicant submits that the next action, which should clarify the record, cannot be a final action.

CONCLUSION

In view of the foregoing amendments and remarks, Applicant submits that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicant hereby makes a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 19-0089.

Respectfully submitted,
Steven D. SLONAKER



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